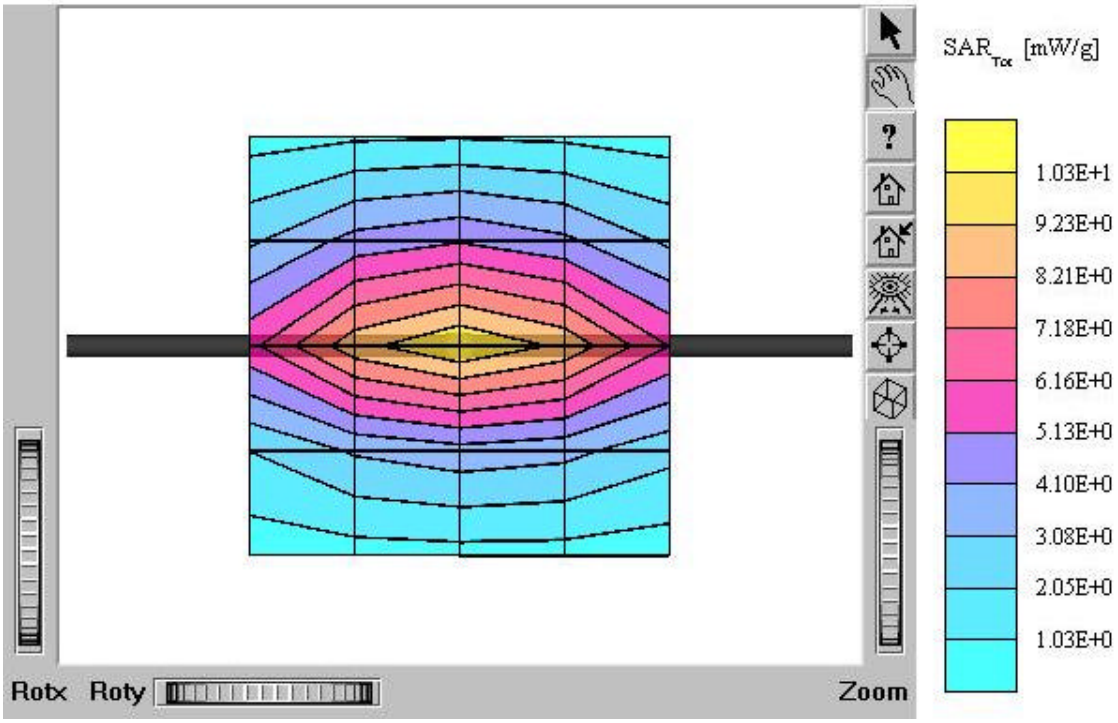
ATTACHMENT Q – DIPOLE VALIDATION

Validation Data (835MHz Brain)

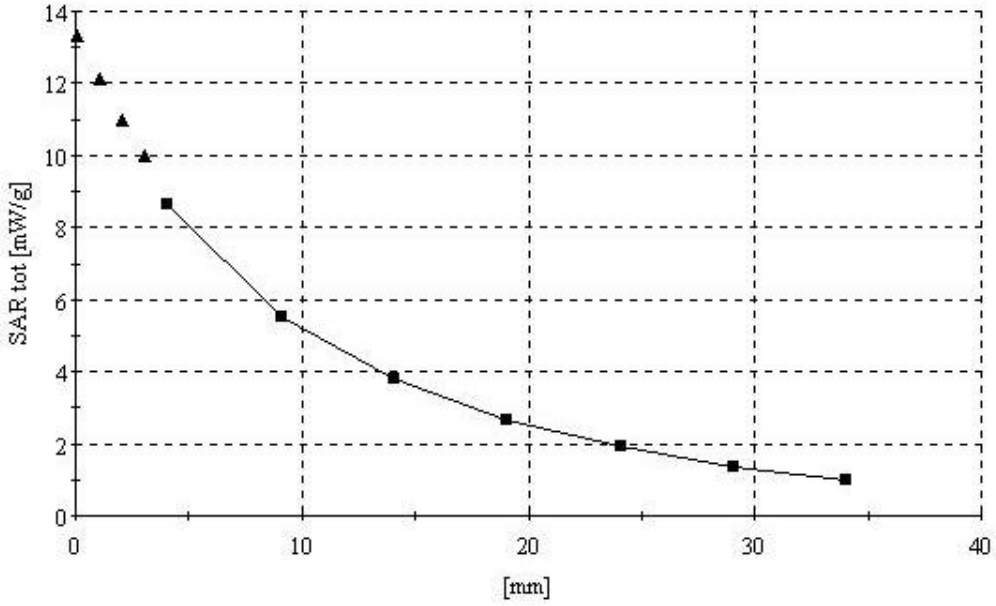
Dipole 835 MHz
SAM I Phantom; Flat Section; Position: (90°,90°); Frequency: 835 MHz
Probe: ET3DV6 - SN1608; ConvF(6.50,6.50,6.50); Crest factor: 1.0; Brain 835 MHz: σ = 0.88 mho/m ε_r = 41.4 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 10.1 mW/g ± 0.00 dB, SAR (10g): 6.44 mW/g ± 0.00 dB
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.01 dB
Comment:
835MHz Brain Dipole Validation (D835V2/ S.N: 441)
Antenna Input Power : 30 dBm (1W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature : 21.5 ℃
Date Tested : August 1, 2003



Dipole 835 MHz

SAM I Phantom; Flat Section; Position: (90°,90°); Frequency: 835 MHz
Probe: ET3DV6 - SN1608; ConvF(6.50,6.50,6.50); Crest factor: 1.0; Brain 835 MHz: σ = 0.88 mho/m ε_r = 41.4 ρ = 1.00 g/cm^3
Cubes (2): SAR (1g): 10.1 mW/g ± 0.00 dB, SAR (10g): 6.44 mW/g ± 0.00 dB
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0

Comment:
835MHz Brain Dipole Validation (D835V2/ S.N: 441)
Antenna Input Power : 30 dBm (1W)
HCT Co., Ltd. Brain Tissue Simulating Liquid
Liquid Temperature : 21.5 ℃
Date Tested : August 1, 2003



Dielectric Parameter (835MHz Brain)

Title : HTP-800
SubTitle : 835 MHz Brain
August 01, 2003 09:10 AM

Frequency	e'	e''
800.000000 MHz	41.9147	19.1213
805.000000 MHz	41.8524	19.0562
810.000000 MHz	41.7701	19.0726
815.000000 MHz	41.7263	19.0679
820.000000 MHz	41.6535	19.0713
825.000000 MHz	41.5415	19.0434
830.000000 MHz	41.4909	19.0412
835.000000 MHz	41.4330	19.0097
840.000000 MHz	41.3493	19.0695
845.000000 MHz	41.2877	19.0916
850.000000 MHz	41.2547	19.0641
855.000000 MHz	41.1801	19.0694
860.000000 MHz	41.1662	19.0677
865.000000 MHz	41.1030	19.0700
870.000000 MHz	41.0595	19.0667
875.000000 MHz	41.0276	19.1006
880.000000 MHz	40.9675	19.0519
885.000000 MHz	40.8502	19.0104
890.000000 MHz	40.8086	18.9675
895.000000 MHz	40.7284	18.9265
900.000000 MHz	40.6899	18.9233

¦ Dielectric Parameter (835MHz Body)

Title : HTP-800
SubTitle : 835 MHz Body
August 01, 2003 08:55 PM

Frequency	e'	e''
800.000000 MHz	54.4473	20.2919
805.000000 MHz	54.3088	20.2854
810.000000 MHz	54.2697	20.3001
815.000000 MHz	54.1969	20.2486
820.000000 MHz	54.1171	20.2670
825.000000 MHz	54.0538	20.2961
830.000000 MHz	53.9697	20.3548
835.000000 MHz	53.9177	20.2861
840.000000 MHz	53.8484	20.2574
845.000000 MHz	53.8564	20.2875
850.000000 MHz	53.8282	20.2763
855.000000 MHz	53.8020	20.2967
860.000000 MHz	53.7366	20.2672
865.000000 MHz	53.7239	20.2609
870.000000 MHz	53.6675	20.2498
875.000000 MHz	53.6719	20.2422
880.000000 MHz	53.6431	20.2155
885.000000 MHz	53.6006	20.1784
890.000000 MHz	53.6029	20.1871
895.000000 MHz	53.5226	20.1025
900.000000 MHz	53.4911	20.1140

ATTACHMENT S – DIPOLE CALIBRATION DATA

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

835 MHz System Validation Dipole

Type:	**D835V2**
Serial Number:	**441**
Place of Calibration:	**Zurich**
Date of Calibration:	**August 3, 2001**
Calibration Interval:	**24 months**

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

Approved by:

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D835V2

Serial: 441

Manufactured: March 9, 2001
Calibrated: August 3, 2001

1. Measurement Conditions

The measurements were performed in the flat section of the new generic twin phantom filled with head simulating solution of the following electrical parameters at 835 MHz:

Relative Dielectricity	**41.0**	± 5%
Conductivity	**0.89 mho/m**	± 5%

The DASY3 System (Software version 3.1c) with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.27 at 900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 5x5x7 fine cube was chosen for cube integration. Probe isotropy errors were cancelled by measuring the SAR with normal and 90° turned probe orientations and averaging.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement

Standard SAR-measurements were performed with the phantom according to the measurement conditions described in section 1. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values are:

averaged over 1 cm^3 (1 g) of tissue:	**10.64 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**6.80 mW/g**

Note: If the liquid parameters for validation are slightly different from the ones used for initial calibration, the SAR-values will be different as well.

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.390 ns**	(one direction)
Transmission factor:	**0.996**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance holder was in place during impedance measurements.

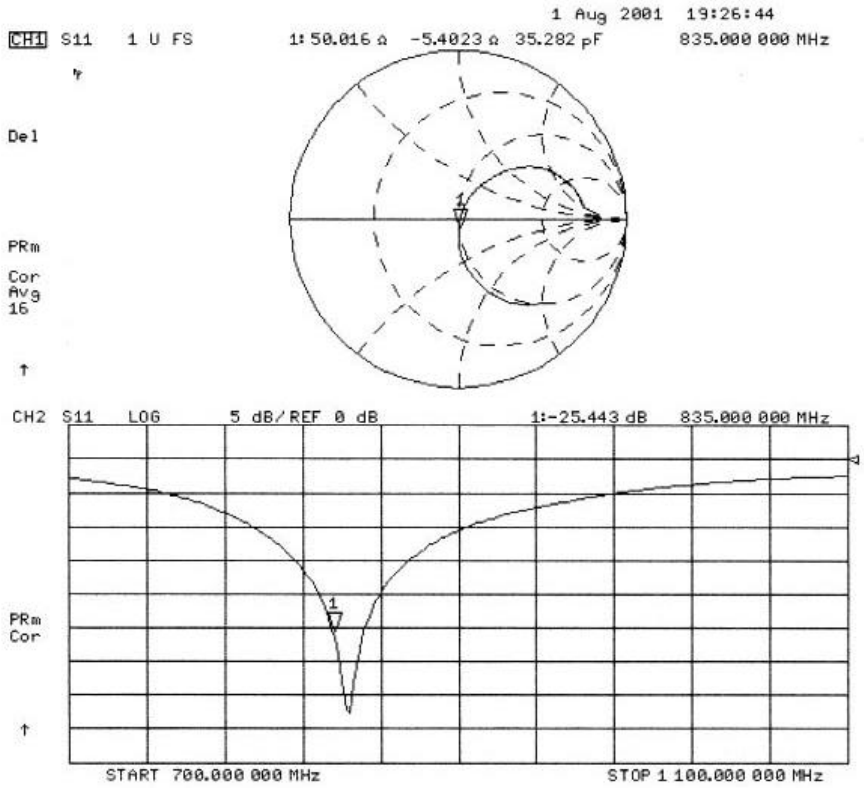
Feedpoint impedance at 835 MHz:	Re{Z} = **50.0 Ω**
	Im {Z} = **-5.4 Ω**
Return Loss at 835 MHz	**-25.4 dB**

4. Handling

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Do not apply excessive force to the dipole arms, because they might bend. If the dipole arms have to be bent back, take care to release stress to the soldered connections near the feedpoint; they might come off.

After prolonged use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.


1 Aug 2001 19:26:44
CH1 S11 1 U FS
1: 50.016 Ω -5.4023 Ω 35.282 pF
835.000 000 MHz
Del
PRm
Cor
Avg
16
CH2 S11 LOG
5 dB/ REF 0 dB
1:-25.443 dB 835.000 000 MHz
PRm
Cor
START 700.000 000 MHz
STOP 1 100.000 000 MHz

08/01/01

Validation Dipole D835V2 SN:441, d = 15 mm

Frequency: 835 MHz; Antenna Input Power: 250 [mW]
SAM Phantom; Flat - SAM Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.27,6.27,6.27) at 900 MHz; IEEE1528 835 MHz; σ = 0.89 mho/m ε_r = 41.0 ρ = 1.00 g/cm^3
Cubes (2): Peak: 4.25 mW/g ± 0.03 dB, SAR (1g): 2.66 mW/g ± 0.03 dB, SAR (10g): 1.70 mW/g ± 0.03 dB, (Worst-case extrapolation)
Penetration depth: 12.0 (10.6, 13.8) [mm]
Powerdrift: -0.00 dB

Schmid & Partner Engineering AG, Zurich, Switzerland

ATTACHMENT R – PROBE CALIBRATION DATA

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

Client Hyundai (Dymstec)

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1606
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	June 9, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	
Approved by:	Fin Bomholt	R&D Director	

Date issued: June 9, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Probe ET3DV6

SN:1608

Manufactured: July 27, 2001
Last calibration: August 20, 2001
Recalibrated: June 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1608 June 9, 2003

DASY - Parameters of Probe: ET3DV6 SN:1608

Sensitivity in Free Space

Diode Compression

NormX	1.77 $\mu V/(V/m)^2$	DCP X	92	mV
NormY	1.58 $\mu V/(V/m)^2$	DCP Y	92	mV
NormZ	1.87 $\mu V/(V/m)^2$	DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5 ± 9.5% (k=2)	Alpha	0.39
ConvF Z	6.5 ± 9.5% (k=2)	Depth	2.44

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2 ± 9.5% (k=2)	Alpha	0.48
ConvF Z	5.2 ± 9.5% (k=2)	Depth	2.68

Boundary Effect

Head 900 MHz **Typical SAR gradient: 5 % per mm**

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	9.7	5.5
SAR_{be} [%]	With Correction Algorithm	0.3	0.5

Head 1800 MHz **Typical SAR gradient: 10 % per mm**

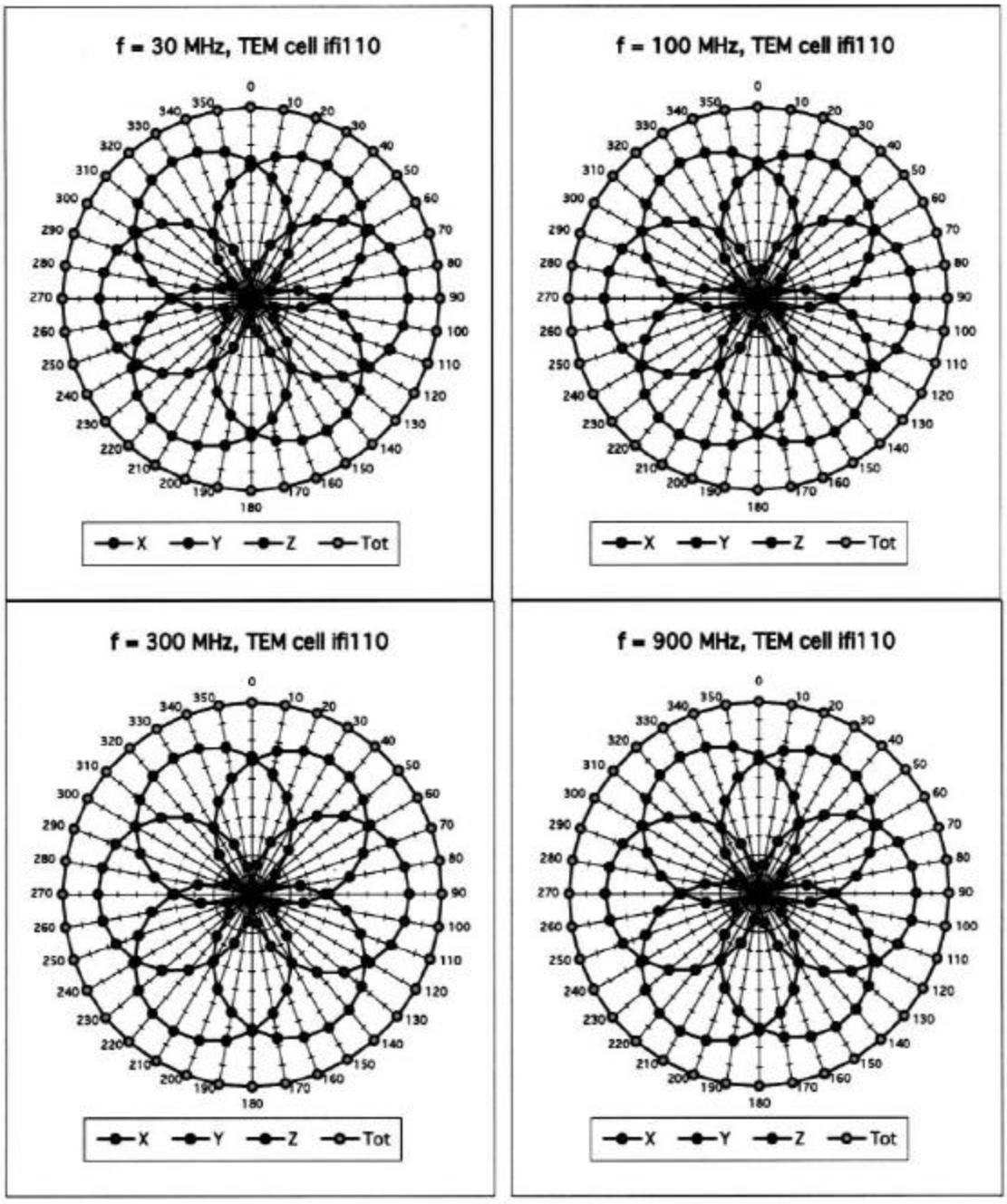
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	13.4	9.1
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.5 ± 0.2	mm

ET3DV6 SN:1608 June 9, 2003

Receiving Pattern (ϕ), θ = 0°



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SAN 136-1, AMI-RI , BUBA L-EUP, ICHEON-SI,KYOUNKI-DO, 467-701,KOREA
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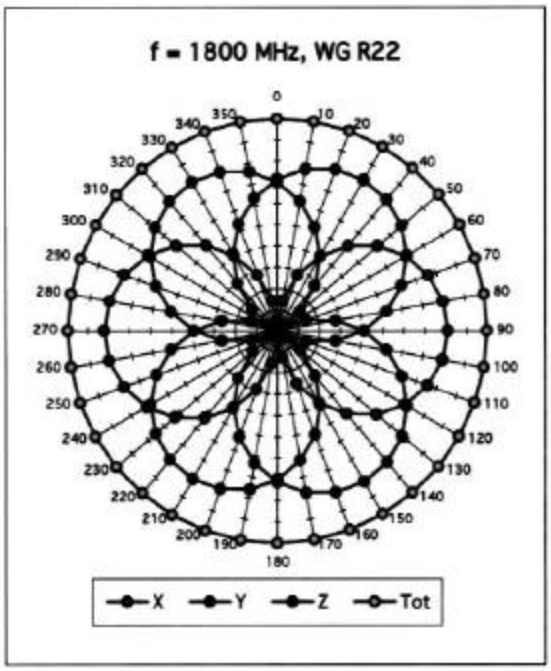
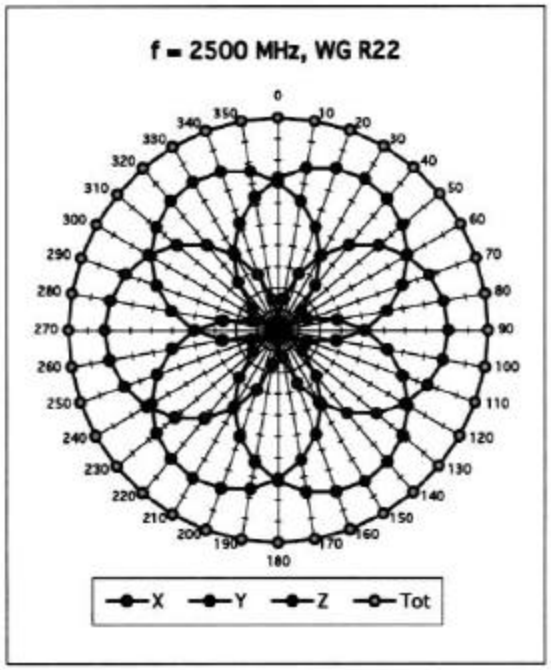
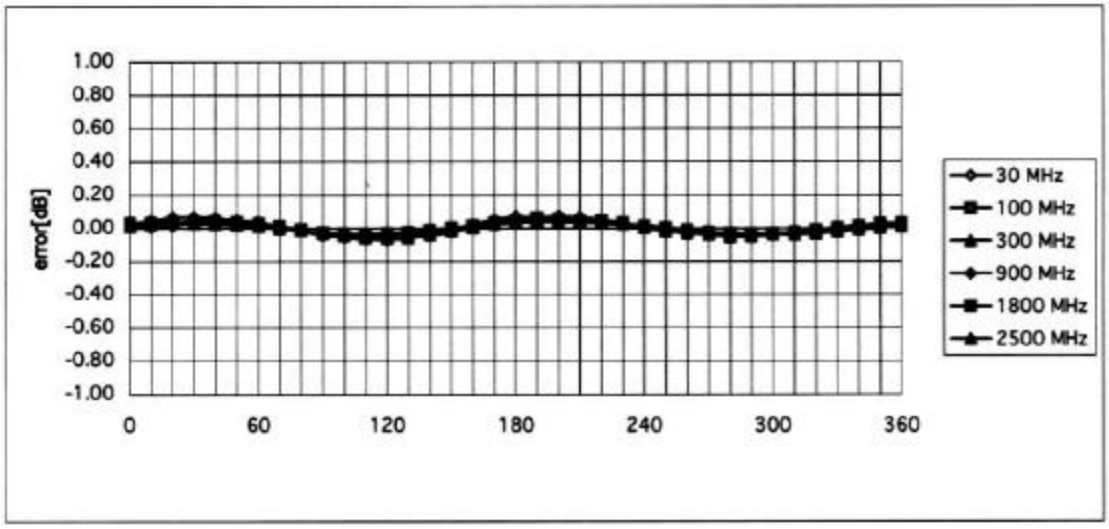
ET3DV6 SN:1608 June 9, 2003





Isotropy Error (ϕ), θ = 0°



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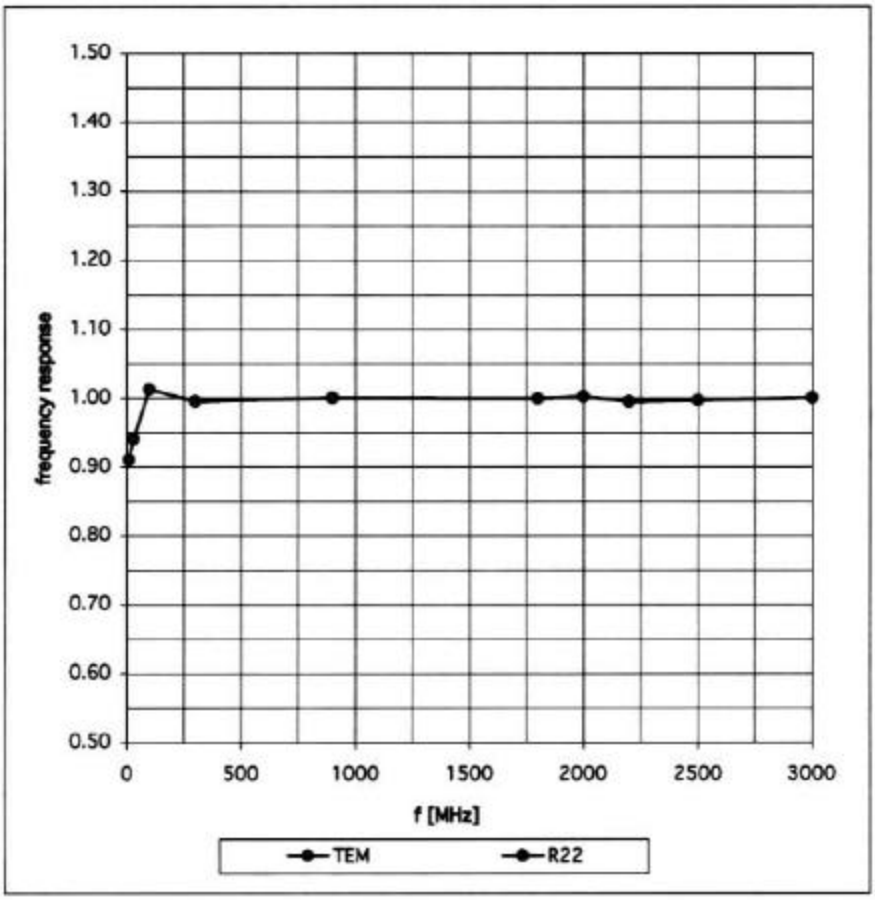
SAN 136-1, AMI-RI , BUBA L-EUP, ICHEON-SI,KYOUNKI-DO, 467-701,KOREA
TEL : +82 31 639 8518 FAX : +82 31 639 8525 www.hctec.co.kr

ET3DV6 SN:1608 June 9, 2003

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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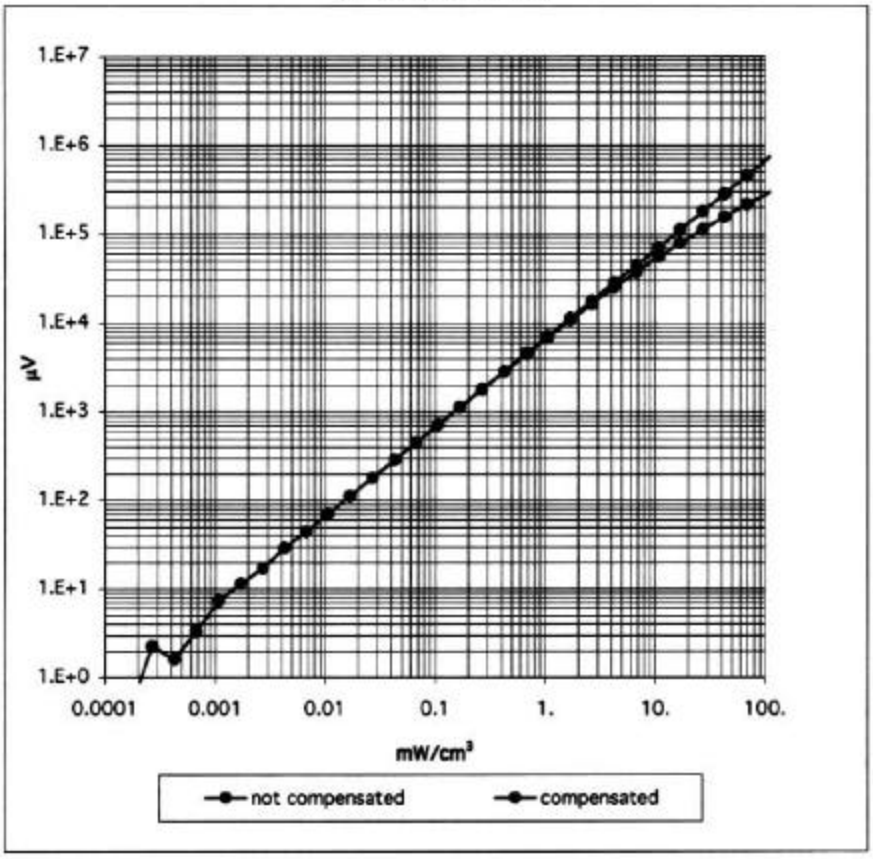
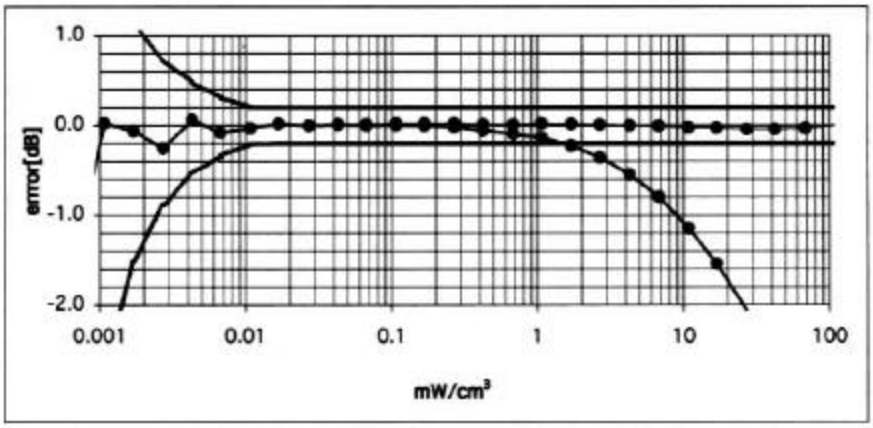
ET3DV6 SN:1608 June 9, 2003

Dynamic Range f(SAR_{brain})

(Waveguide R22)





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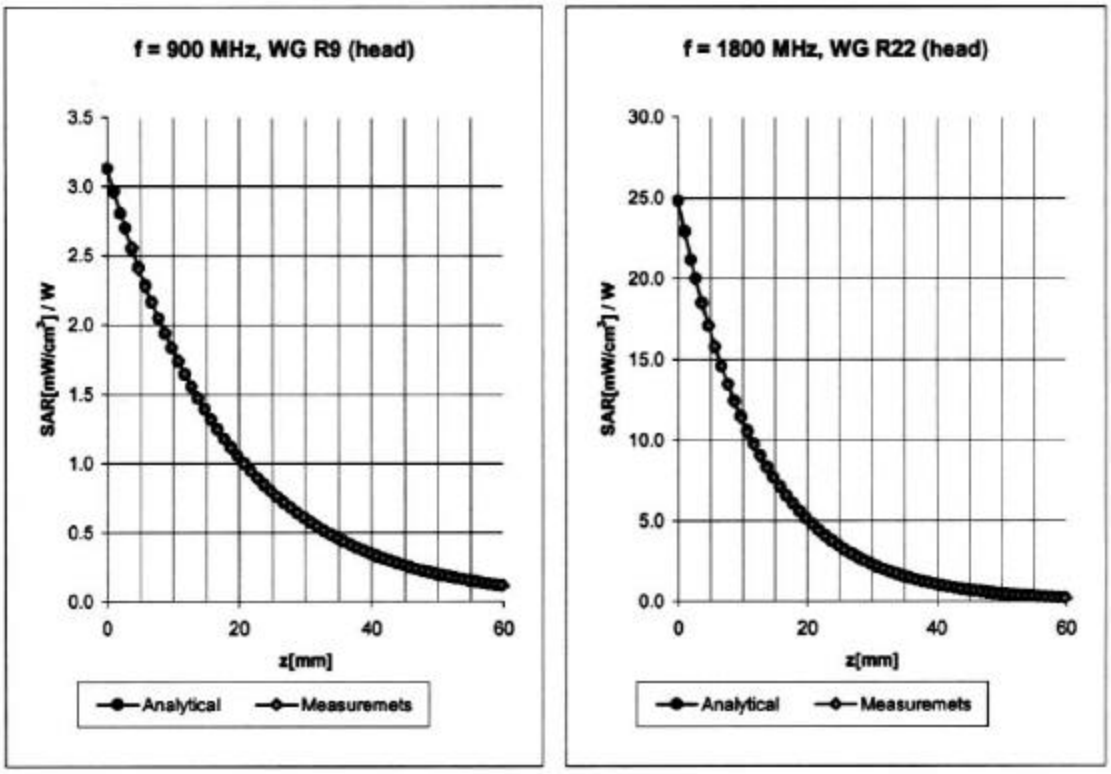
ET3DV6 SN:1608 June 9, 2003

Conversion Factor Assessment



Head	900 MHz	ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5 ± 9.5% (k=2)	Alpha	0.39
ConvF Z	6.5 ± 9.5% (k=2)	Depth	2.44

Head	1800 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.2 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2 ± 9.5% (k=2)	Alpha	0.48
ConvF Z	5.2 ± 9.5% (k=2)	Depth	2.68

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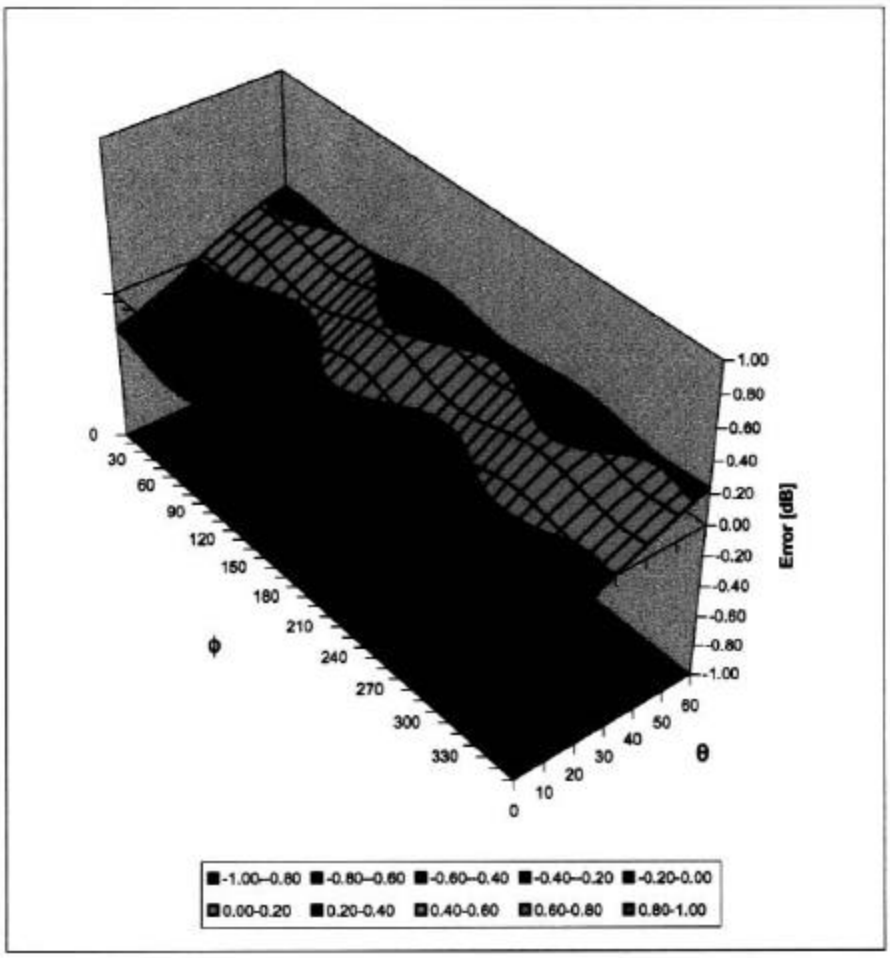
SAN 136-1, AMI-RI , BUBA L-EUP, ICHEON-SI,KYOUNKI-DO, 467-701,KOREA
TEL : +82 31 639 8518 FAX : +82 31 639 8525 www.hctec.co.kr

ET3DV6 SN:1608 June 9, 2003

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

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Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	ET3DV6
Serial Number:	1608
Place of Assessment:	Zurich
Date of Assessment:	June 23, 2003
Probe Calibration Date:	June 9, 2003

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by: [redacted]

Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

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Dosimetric E-Field Probe ET3DV6 SN:1608

Conversion factor (± standard deviation)

835 MHz	ConvF	6.3 ± 8%	ε_r = 55.2 ± 5% σ = 0.97 ± 5% mho/m (body tissue)
1900 MHz	ConvF	4.7 ± 8%	ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m (body tissue)
450 MHz	ConvF	7.4 ± 8%	ε_r = 43.5 ± 5% σ = 0.87 ± 5% mho/m (head tissue)
450 MHz	ConvF	7.5 ± 8%	ε_r = 56.7 ± 5% σ = 0.94 ± 5% mho/m (body tissue)